Periodic Table Notes: History and Information

In the Beginning

- Prerequisite to the construction of the periodic table _____ _____the next 200 years, chemists acquired a vast body of knowledge concerning the properties of elements
- By 1869, a total of _____

Law of Triads

- In 1817_____, after discovering the halogen triad composed of chlorine, bromine, and iodine and the alkali metal triad of lithium, sodium and potassium he _____ _____ _____ _____(**the Law of Triads**).

First Attempts At Designing a Periodic Table

- deChancourtois transcribed a list of the _____ _____
- When the cylinder was constructed so that 16 mass units could be written on the cylinder per turn, _____ _____
- This led deChancourtois to propose that _____ _____

- Law of Octaves

- In 1863 John Newlands classified the 56 established elements into _____ _____ _____
- Noting that many pairs of similar elements existed which differed by some multiple _____ _____Law of Octaves

The Law of Octaves stated that any given element _____ _____ _____ _____

Who Is The Father of the Periodic Table?

- There has been some disagreement about who deserves credit the German _ _____or the Russian _____
- Both chemists produced remarkably similar results at the same time working independently of one another.
- Meyer's 1864 textbook included a _____
- In 1869, Dmitri Mendeleev organized his material in terms of _____ _____ _____
- He observed similarities between the series Cl-K-Ca , Br-/Rb-Sr and I-Cs-Ba.
- In an effort to extend this pattern to other elements, _____ _____
- Each card contained the element's symbol, atomic weight and its characteristic_____.
- From this table, Mendeleev developed his statement of the periodic law and published his work

- The advantage of Mendeleev's table over previous attempts was that it exhibited _____
_____
_____
- However, even after redetermining atomic weights, some elements still needed to be placed out of order of their atomic weights.
- From the gaps present in his table, _____
_____
_____
_____
- The elements _____were found later to fit his predictions quite well.
- Even if Mendeleev's table was published before Meyers', his work was_____
_____
_____

In all Mendeleev predicted the existence of 10 new elements, of which seven were eventually discovered -- the other three, atomic weights 45, 146 and 175 do not exist.

Discovery of the Noble Gases

- In 1895, the discovery of a new gaseous element named argon, which proved to be chemically inert and did not fit any of the known periodic groups.
- In 1898, argon was placed into the periodic table between chlorine and potassium in a family with helium
- It remained for the discoveries of scientists of the 20th Century to explain why the properties of the elements recur_____.

- With the discovery of isotopes of the elements, it became apparent that atomic weight was not the significant player in the periodic law as Mendeleev, Meyers and others had proposed.
- It has become quite clear that the properties of the elements varied periodically with _____
- The question of why the periodic law exists was answered as scientists developed an understanding of _____

The Modern Periodic Table

- The last major changes to the periodic table resulted from _____ _____
- Starting with his discovery of _____in 1940, he discovered all the transuranic elements from 94 to 102.
- He reconfigured the periodic table by placing the _____ _____
- In 1951, Seaborg was awarded the Nobel Prize in chemistry for his work. Element 106 has been named seaborgium (Sg) in his honor.

Parts of the Periodic Table

- Rows on the Periodic Table are called _____
  - They are number 1 to 7. These numbers correspond to _____
    _____
- The columns on the Periodic Table are called _____
  _____
  - The elements are grouped according to the physical and chemical properties.
  - The columns a numbered 1 to 18
  - The old system used Roman numerals and letters to denote groups and subgroups

Element Families on the Periodic Table

- The 112 elements can be divided, by their properties, into 9 separate families (groups).
- These groups are _____
  _____
  _____

Alkali Metals

- Found in _____
- Are very reactive metals that do not_____
- These metals have only _____electron in their outer shell.
- Therefore, they are ready to lose that _____electron in ionic bonding with other elements.
- The alkali metals are _____
  _____
- Have _____characteristics
- Cesium and francium are the _____
- The oxidation number for these metals is always _____

Alkaline Earth Elements

- The alkaline earth elements are metallic elements found in_____
- The alkaline earth elements are: _____

  _____
- All alkaline earth elements have _____electrons to give away
- The oxidation number of_____, which makes them very reactive.

Transition Metals

- 38 elements in groups _____of the periodic table are called "transition metals".
- Have the properties of _____
- The interesting thing about transition metals is that _____

  _____

  _____
- Three noteworthy elements in this family are_____

  _____,

  and are the only elements known to produce a _____field.
- The oxidation numbers_____

Other Metals

- 7 elements classified as "other metals" are located in _____
- they are not the same as the _____elements. These elements, unlike the transition elements, do not exhibit _____ ____oxidation states, and their valence electrons are only present in their_____ _____.
- They have oxidation numbers of_____

Rare Earth Elements

The thirty rare earth elements are composed of the lanthanide and actinide series. One element of the lanthanide series and most of the elements in the actinide series are called_____, which means

synthetic or man-made. All of the rare earth metals are found in Group ___ ___ of the periodic table, and the 6th and 7th periods. All rare earth elements have _____ electrons in their outer shells. They have varying oxidation numbers that are always _____

Non-Metals

- Non-metals are the elements in groups _____
- Non-metals are not able to conduct electricity or heat very well.
- These elements show non-metallic characteristics. The non-metals are in all two or the three states of matter at room temperature' gases (such as oxygen) and solids (such as carbon).
- They have oxidation numbers of: _____

Metalloids

- Metalloids are the elements found along the stair-step line that distinguishes metals from non-metals.
- This line is drawn from between _____and_____to the border between _____and _____.
- **Only** exception to this is_____, which is considered to be an "other metal".
- Metalloids have properties of both_____.
-
- metalloids, such as_____, are semi-conductors. This means that they can carry an electrical charge under special conditions. This property makes metalloids useful

in _____

Halogens

The halogens are five non-metallic elements found in Group 17

These elements are:_____

_____.

The term "halogen" means "salt-former" and compounds containing halogens are called_____ ".

All halogens have _____electrons in their outer shells, giving them an oxidation number of _____

The halogens exist, at room temperature, in all three states of matter:

Solid- Iodine, Astatine **Gas-** Fluorine, Chlorine
Liquid- Bromine

Noble Gases

- The six noble gases are found in_____.
- These elements are: helium, neon, argon, krypton, xenon, and radon.
- Because their oxidation number is_____,the noble gases have great difficulty forming compounds.
- All noble gases have 8 electrons in their outer shell, making them stable.

Periodic Table: Periodicity of Properties

- With increasing atomic number,
  - the electron configurations of_____.
  - Because of this the elements show periodic variations of both _____

    _____

    _____
  - The periodic law states that _____

    _____
  - Four physical properties of an atom: atomic radius, ionization energy, electron affinity and electronegativity.

Atomic Radius

- The size of the electron cloud increases as the principal quantum number increases.
- Therefore, as you go down a group of elements, the size of atoms in is going to increase.

Atomic Radius

- Left to right across a period, all the atoms have _____
- For each element, the positive charge on the nucleus increases by ____ proton. This means that the outer electron cloud is pulled in a little closer to the nucleus.
- One periodic property of atoms is that they tend to _____in size from left to right across a period of the table.
- So here is the trend for atomic radii: _____

  _____

  _____

Ionization Energy

- energy needed to remove the _____ _____from an atom is known as ionization energy.
- The ionization energy tends to _____as atomic number increases in any period.
- In any group, there is a gradual _____in ionization energy as the atomic number increases because the electrons being removed are _____from the nucleus.
- However it is more difficult to remove other electrons because of greater pull from the nucleus.
- Metals typically have _____ionization energy. (easy to remove e^{-1})
- Nonmetals typically have _____ionization energy.(hard to remove)

Electron Affinity

- The attraction of an atom for an electron is called _____
- Metals have _____ electron affinities (don't want electrons)
- Nonmetals have _____electron affinities. (really want electrons)
- The general trend as you go down a group is a _____ tendency to gain electrons.
- As you go across a period there is a trend for a _____attraction for electrons.

Electronegativity

- Electronegativity is measure of the power of an atom in a chemical bond to attract electrons.
- This is measured in Pauling units.
- The electrons involved in a chemical bond are called _____
- These are found in the _____energy levels
- The bonding electrons are usually _____orbital electrons.

- In a group, electronegativity will _____as you go down or remain almost the same.
- Across a period there is a gradual _____in electronegativity.
- Nonmetals are generally _____electronegative than metals.
- The Halogens are the _____electronegative and the alkali
- alkaline earth metals are the _____electronegative.
- Atomic radius also plays apart.
  - **Larger** more easily ionized **atoms** will **not attract electrons as strongly**.
  - **Fluorine is the most electronegative element** on the Periodic Table.

Filling of Electron Sublevels and the Periodic Table

The outermost electron configuration can be determined from the Periodic Table. The order of fill of electrons is directly related to the Periodic Table (long form is easier). Here is how it works:

1. The elements in Groups 1 and 2 are filling the ____sublevel.
   Examples: Li and Be are in the second period and fill the 2*s*.
   Na and Mg will fill the 3*s* and so it goes.

2. The elements in groups 13-18 fill the _____sublevels, which can hold 6 electrons.
   The *p* sublevels begin to fill in the ____period with boron (B) and is completed with Ne.
   In the third period Al to Ar complete the 3*p* sublevel.

3. The transition metals in Groups 3-12 fill the _____sublevels.
   Remember *d*'s can hold ___ electrons.
   We do not see *d* sublevels until the _____ period.
   The _____ is already filled. Elements 21 to 30 fill the _____sublevel and 39 to 48 fill the _____ sublevel.

Note: the principal quantum of the *d* sublevel being filled is always one less than the period number.

4. The two sets of elements that sit at the bottom of the short Periodic Table contain 14 elements. These are called the _____ metals and found in periods ___ and__. The *f* sublevels are being filled and can hold 14 elements. The principal quantum number for the *f* sublevels is 2 less than the period. (Period 6 the 4*f* fills and Period 5 fills the 5*f*)

So. Here is it is the way to figure outer most electron configuration.
n is the period or principal quantum number.

Group	1	2	13	14	15	16	17	18
Outer configuration	**n**s^1	**n**s^2	**n**s^2**n**p1	**n**s^2**n**p^2	**n**s^2**n**p^3	**n**s^2**n**p4	**n**s^2**n**p^5	**n**s^2**n**p^6

Okay some problems. In **Groups 3-12** the outer most electrons are always in **n**s^2. BUT the ***d* orbitals are filling**. SO ***s* and *d* electrons can sometimes move between sublevels creating different outer shell configurations.**

Ion Formation

The elements before and after Noble gases form ions by gaining or losing electrons until they have the same electron configuration as the a noble gas

N^{-3} O^{-2} F^{-1} Ne Na^{+1} Mg^{+2} Al^{+3}

All of the above ions have the same electron configuration: $1s^2$ $2s^2$ $2p^6$

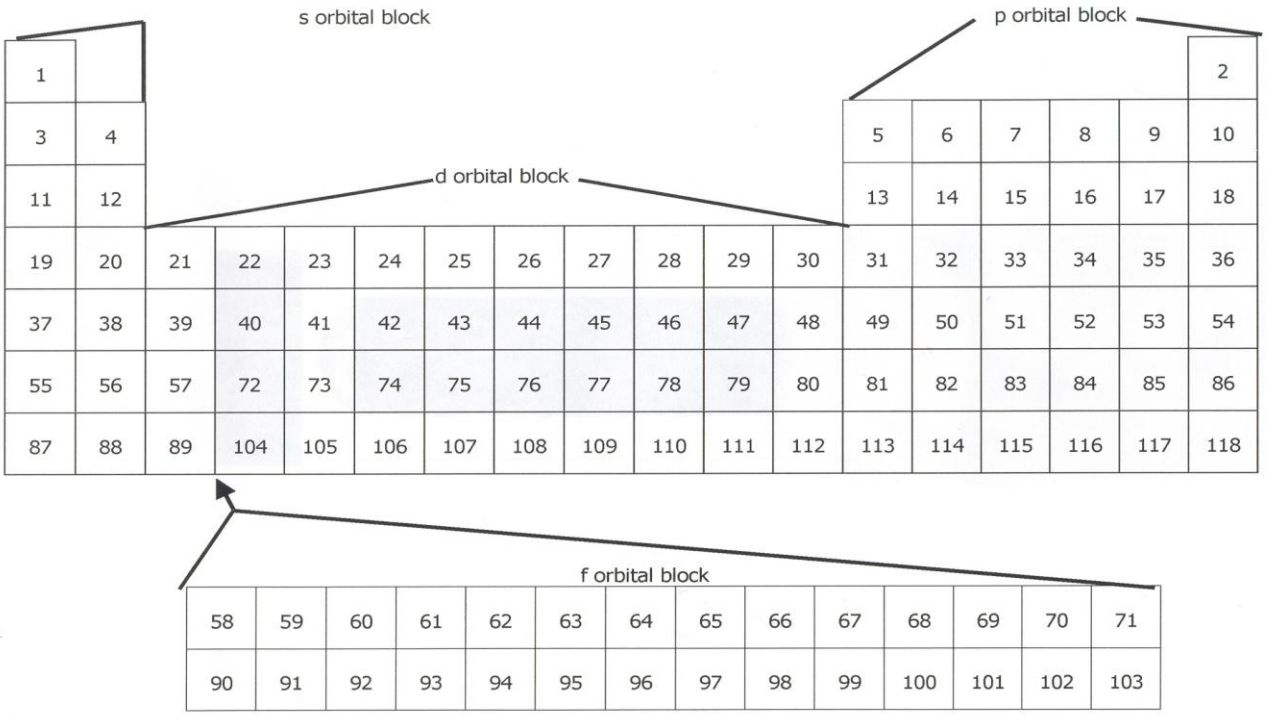
These ions and atoms are said to be isoelectronic meaning same electron configuration

Keep in mind
gain electrons = a (-) charge
lose electrons = a (+) charge

Some forms of the Periodic Table

Short form (usual form)

Chemistry I: Electron Configuration and the Periodic Table



Chemistry I: Periodic Table & Electron Configuration / Order of Fill